**Harmonic Motion Summary Sheet**

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| **Springs – restoring force (kx) is opposite the displacement of the spring** | |
| 1. A spring supplies a “restoring force”. That is, the spring will tend to return to its equilibrium position if disturbed. 2. When spring is disturbed in the “-x” direction, the spring force is +kx. 3. When the spring is disturbed in the “+x” direction, the spring force is –kx.   **Restoring force: Hooke’s Law**  **F = -kx** where k = spring constant (N/m)  x = displacement of spring (m)  **Spring Potential Energy**  PEspring = ½ kx2 J |  |
| **Harmonic Motion** | |
| k = spring constant (N/m)  m = mass (kg) | |
| **Spring/Mass Systems and Energy** | |
| The energy of a spring/mass oscillator is fixed.  PEmax = ½ kx2 = KEmax = ½ mv2  As the mass moves, KE is traded for PE and visa versa. | Etot = KE + PEspring + PEgravity  = ½mv2 + ½kx2 + mgh |

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| **Pendulums** | | |
| 1. A simple pendulum is a mass “m” suspended by a string of length L. 2. Frequency of oscillation depends only on gravity and the length of the pendulum. 3. The pendulum follows simple harmonic motion if the amplitude is not too large (< 30 degrees).   Hz | | P:\Handley HS\AP Physics - Mech\Tipler\Text Images\ch14\figure-14-32.jpg |
| **Pendulum and Spring/Mass undergo very similar motion** | | |
| 1. At maximum deflection, velocity is zero and acceleration is maximum. 2. At zero deflection, velocity is maximum and acceleratino is zero. 3. For a spring/mass, the frequency of oscillation depends on the spring constant (k) and mass (m). 4. For a pendulum, the frequency of oscillation depends on gravity and the length of the pendulum. |  | |
| **Resonance** | | |
| 1. When the applied force is “in sync” with the “natural frequency” of an object, we get resonance and the motion of the object grows with time. 2. Resonance can be very destructive (Tacoma Bridge) | | |